AMATEUR WORK

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ELEMENTARY SHOP PRACTICE.

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I. MARKING AND LAYING OUT.

Shop practice, even elementary shop practice, covers such a vast field and can be approached from so many different points of view, that it is an impossible task to undertake to place on paper in definite form the views of any one man and call them the best treatise on the subject. The subject matter in the following articles is the result of the writer's personal observations during more than twenty years of active work, supervision and teaching, and is presented, not as a complete exposition of the topic, but more as hints of a practical character for the benefit of the student and the amateur workman. For this reason, the writer assumes that a large majority of his readers are without any knowledge of the shop and its customs, and will endeavor to treat the subject from that point of view.

Before considering the true shop operation of removing metal, it will be to our advantage to analyze the preliminaries, such as marking, laying out, etc.

It is evident that no work can be properly done which has not been carefully planned, not only in the brain of the designer, but also in the form of drawings for the guidance of the workmen. From the drawings the machinist gets, or should get, a clear conception of the completed machine and its several parts. Applying this conception to the castings, forgings, etc., furnished for the machine, he not only sees where and in what quantity metal should be removed, but it aids him in partially reproducing the drawing on the surface of the metal to be used. This reproduction, which the machinist calls "laying out," consists principally in drawing lines and circles to represent the boundaries of surfaces and in placing points to locate the centres of holes.

These lines and points must be easily seen, and it is not often that this result can be obtained by drawing directly on the metal. A proper background must be provided, and the machinist's first resort for this purpose is chalk, which is rubbed on the metal, producing a grayish-white surface. If the piece is to be subjected to much rough handling, pounding, etc., or if oil is to be used, the chalk will gradually disappear and the line will be lost, unless, as is usual in such cases, the line has been marked by a series of light dots, pricked into the metal with a punch. For a more permanent back-ground, white lead paint applied with a brush is often used, while for laying out polished steel surfaces, a film of copper, produced by rubbing the surface with a piece of copper sulphate or blue vitriol moistened with water, makes a sharp contrast with the lines drawn through it to the bright steel below.

Many of the rules applying to mechanical drawing are useful to the process of laying out. For instance, the lines should be clear and sharp, lines drawn for the location of points should be as nearly at right angles as possible, and the points should be represented by very light dots carefully located exactly at the points of intersection. The marking tools must be kept in good order, and the whole process of laying out should be as carefully performed as if with clean hands on fine paper.

As instruction in geometry and drawing proceeds along the natural sequence of point, line, surface, and solid, so also does the marking, laying out, and measuring of the machinist follow the same course. Tools for these operations are in almost constant use and should form an important part of every workman's kit; hence it seems wise to describe the more common forms before giving any examples of how they are to be used.

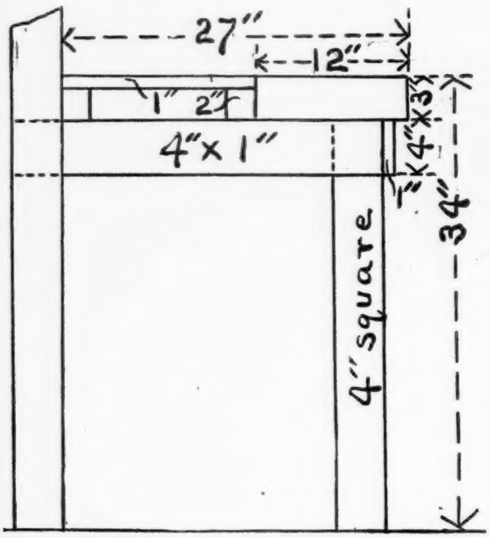


FIG. 1. THE BENCH.

Before describing the tools mentioned in the last paragraph, the bench used for ordinary shop operations deserves a little notice. It should be about 2′ 10″ high and 2′ 3″ wide, the front being of maple or rift ash plank not less than 3″ thick. It is the poorest kind of economy to make a light bench for machinists' use. The uprights may be 4″ square spruce, toe-nailed to the floor, and the rest of the frame of 4″×1″. The bench should slope slightly toward the wall, so work will not roll to the floor. Questions of light, floor construction, heating, and ventilation are too technical to be considered in an elementary treatise.

The vise should be fastened to the plank so that the face of the fixed or rear jaw is flush with the front of the bench, and as near an upright as possible. The first precaution allows long work to hang below the level of the bench, and the second, together with the heavy plank, renders the whole affair rigid.

The vise itself consists of a fixed jaw, a movable jaw, screw, nut, handle, and a device for separating the jaws when opening the vise. The fixed and movable jaws are made of cast iron, the

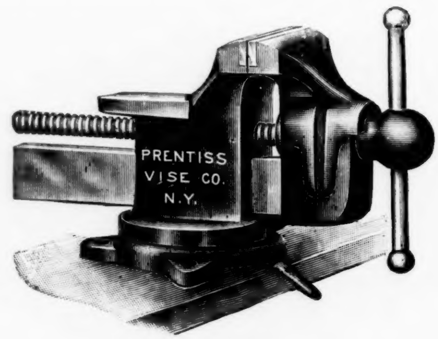


FIG. 2. SWIVEL VISE.

screw and handle of machine steel, and the nut of malleable iron. The jaws are provided with removable faces of cast steel, usually checkered to give a firm grip on the work. For holding taper work, the rear jaw is sometimes made to swivel and so adjust itself to the work. The base may be of the rigid or swivel type, the swivel base and jaw being of great convenience to the machinist who is doing a large variety of work. The size of the vise is designated by the length of the jaw, the 4″ being a good size for ordinary use. False jaws of brass, lead, or leather are used to prevent marring the work by the checkered jaws.

As the hammer is in almost constant use, it belongs to no process in particular and may be described at this time. The hammer-head is of tool steel with the face and peen hardened and drawn to a very dark straw. The peen may be ball, cross, or straight, the last not being in common use. The handle should be of hickory and wedged in the eye so that the axes of the handle and head form a right angle. Some machinists prefer to have the face "hang in" a trifle. The weights run from four ounces to two pounds, and every workman should have at least three, about 4 oz., 12 oz., and 1¼ lbs., the smallest being used with the prick punch and for light riveting, the me-

dium weight for ordinary use, and the largest for heavy chipping, riveting, and all work of a coarse and heavy character.

Fig. 3.
Ball, Straight and Cross Pein Hammers.

The machinist has two uses for the point, first, to form part of a line to be drawn, and, second, to serve as a guide for starting a cutting tool such as a drill. As the two classes of points are radically different, two quite different tools, the prick

Fig. 4. Prick Punch.

punch and the centre punch, are employed. The prick punch should be made of tool steel, hardened and tempered to a light straw. The point should be ground to a true cone at an angle of about 60°. A common size is made from $\frac{1}{4}''$ stock and is about $3\frac{1}{2}''$ long. The long and comparatively slender point adapts it for making small dots which must be carefully located. It is used in connection with a small hammer and should be kept in good condition, as a dull or poorly ground prick punch will introduce errors in the first stages of a piece of work which are hard to correct in the subsequent processes.

The centre punch is also made of tool steel, hardened and tempered to a light straw. The point should be blunter than that of the prick

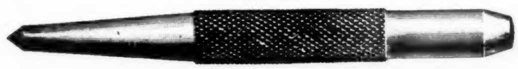


Fig. 5. Centre Punch.

punch, an angle of 90° being the best to stand hard service and to make the necessary indentation in the work. It is also larger and heavier than the prick punch, being usually about 5″ long and made from $\frac{3}{8}''$ stock. A heavier hammer must be used, and the heavy marks made are to emphasize prick punch marks which have been properly located, such as centres for drilled holes.

Fig. 6. The Scriber.

Both the above tools must be so constructed that they will not slip in the fingers, and for this reason the prick punch is usually made from round stock with a knurled grip, while the centre punch is more often made from octagonal steel.

As the line is the next step in the sequence already established, the tools for producing it will now be considered. The scriber or scratch-awl has the same relation to the pencil that the prick punch bears to the needle-point. It is made of $\frac{1}{4}''$ or $\frac{3}{16}''$ tool steel, about 7″ long, and drawn to a long slender point at each end. It is very convenient to have one end bent at right angles about $\frac{1}{2}''$ from the end. The points are hardened and tempered to a light straw. In the common forms square stock is used to afford a good grip for the fingers, while more pretentious instruments are made with a knurled centre-piece and inserted hardened points.

The scriber has very little use as a free-hand instrument. To draw a good line, some form of guide must be provided. The simplest form is the straight-edge, usually a rectangular piece of steel, often not hardened, and from 3″ to several feet in length. The smaller sizes are sometime

beveled on one edge similar to the common foot rule used in drawing. The straight-edge is also used to test plane surfaces, and for this purpose is made in cast iron up to ten feet and over.

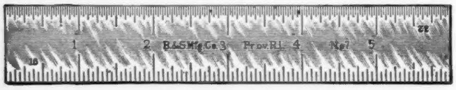


FIG. 7. STEEL RULE.

It is but a step to provide the straight-edge with graduations, thus making it a measuring tool called the steel rule, and, especially in the smaller sizes, the rule is used for both marking and measuring. The best rules are hardened, and the graduations are either cut into the surface before hardening, or etched in with acid after that process. While straight-edges are nearly always flat, rules may be flat, square, or triangular, the flat form being made from 1″ to 3′ in length, while the other two forms are not made over 12″. Rules used for English measurements are usually graduated in 8ths, 16ths, 32nds, and 64ths, one edge devoted to each, al-

FIG. 8. SURFACE GAUGE.

though 100ths are not uncommon. Metric rules can be obtained up to 50 centimeters in length and with graduations as fine as ½ millimeter. What are known as gear cutter's rules have a large number of different graduations, each occupying one inch, giving a multiple of nearly every even number up to 64.

Where lines are to be drawn parallel to any given surface, it is much simpler to use what is known as a surface gage in connection with a bench plate. The bench plate is an ordinary cast iron plate, planed all over, opposite sides parallel, and all angles right angles. The sizes vary from 3″ to several feet square. Large heavy plates flush with the floor and provided with holes for fastening down work are known as floor plates, but may be used for the same purposes as the simpler bench plate. The surface gage usually consists of a cast iron base, a machine steel upright, and a tool steel scriber. The scriber is adjustably fastened to the upright, and when the gage is moved along the surface of the bench plate, the point of the scriber must also move parallel to it.

The above description of tools may seem tedious to some of our readers, but these tools will be used so often and so quickly when actual practice is taken up, that it seems better to describe them now than to stop and explain each when occasion arises for its use. In our next paper, after a description of a few tools for angular measurement, some examples will be taken up which will show the use of these tools, as well as the processes in which they are used.

The trials over the Rome-Paris telephone system are said, according to a foreign contemporary, to have been most successful. The line is 1000 miles in length, and the longest in Europe.

Prof. Artemieff of Russia has invented an armor for protecting electricians or others who find it necessary to work in the vicinity of high-pressure lines. This armor consists of a complete suit of woven wire gauze which the wire man dons when he goes to work. Commenting on this invention, the Electrical Review says: Prof. Artemieff's is good, theoretically, but it can hardly have much practical value. A pair of rubber gloves can be put on more easily, while the usual method of not providing any protection whatever is even less troublesome. Moreover, the life of this armor would not be long, and there are few wire men who will tolerate the irritation produced on the cuticle by but one or two broken ends of wire. Why not make this armor of spun glass cloth?

A SIMPLE RHEOSTAT.

LESTER D. CUSHMAN.

THE average boy has very few tools and therefore desires to make apparatus of as simple a design as possible and yet have it work well. The rheostat here described can easily be made, will be found quite efficient and its capacity can be enlarged by increasing the number of carbons.

First cut out of clear ½″ pine board, a piece 7″ square. Draw lines from corners to locate the centre, and draw a circle 6″ in diameter. Divide this circle into eight equal parts, marking each dividing point, and boring ½″ holes through the board at each point.. Obtain ten or twelve pieces of the carbons used for street arc lights, about 6″ long. These may often be obtained of the "lampmen" for the asking, as they, when replacing new carbons, frequently throw away pieces of about the required length.

If carbons cannot be procured in this way new ones can usually be purchased at any electric lighting station for about three cents apiece for the plated domestic and five cents apiece for the imported, which are not plated. The latter kind would be preferable to use, thus avoiding the work of removing the plating with the acid. Either kind is long enough to make two pieces of the right length for the rheostat.

Put eight of these pieces of carbon into a glass or earthenware dish or jar containing the following solution :

Nitric acid	1 part
Water	16 parts.

Make this solution by pouring the acid into the water slowly, stirring well with a piece of glass. If the solution is retained for future use, it is well to label the bottle, giving formula and adding the word "Poison" in large letters. The necessary quantity of acid will cost but a few cents, and can be purchased at a drug store.

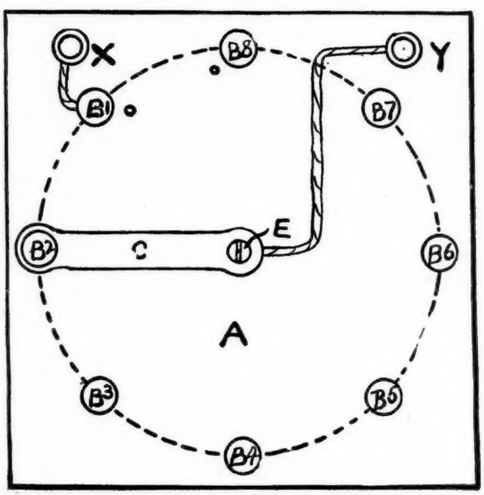


FIG 1.

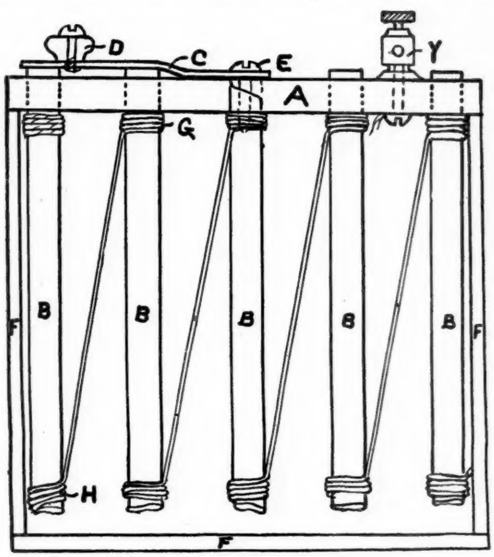


FIG. 2.

The thin electro-plated layer of copper on the outside of the carbons will soon be eaten off by the solution leaving pure carbon bars which should be well washed in water to remove any acid remaining on them. It might be well to leave the plating on about ½″ of one end of the carbons by keeping them free of the acid. This will make the soldering easier.

Now put the carbon pieces in the holes as in Fig. 2, so that the plated ends project above the top about $\frac{1}{8}''$, and turning the board over, pour melted paraffine all around the holes to securely hold the carbons in place.

Two binding posts are placed in the corners X and Y, Fig. 1, and connections made on the under side with No. 18 covered copper wire from post X to carbon B1 and post Y with screw holding switch. The lower part of carbon 1 is then connected by No. 18 covered copper wire with the upper part of carbon 2 as shown in Fig. 2 each carbon being connected in the same way, all connections being soldered with soft solder.

For the lever, cut out a strip of thin spring brass to the shape shown in Fig. 1, making it $3\frac{3}{4}''$ long. A wooden or porcelain knob is fastened to the outer end at D. A small picture knob answers nicely. The inner end is fastened to the board with a machine screw. A box is then made of $\frac{1}{4}''$ or $\frac{3}{8}''$ pine or cedar, 7″ square and $6\frac{1}{2}''$ deep, and to this box is fastened with screws, the board holding the carbons. The rheostat is then ready for use with a motor, coil, or dynamo.

STUDIES IN ELECTRICITY.

XV. THE NERNST LAMP.

The poor efficiency of the usual methods of electric illumination has induced many inventors to endeavor to discover some method of lighting which would be more efficient. The Cooper-Hewett lamp has already been described in an early issue of this magazine, but is not yet in commercial use. It is destined, however, to take a prominent place in the field of electric lighting in the near future. A most important addition now available is the Nernst lamp, so named from the inventor, Dr. Walther Nernst of Goettingen, Germany. It is being introduced in the United States by the Nernst Lamp Company, Pittsburg, Pa., a Westinghouse comsany, which is a sufficient guarantee of good workmansbip and efficiency.

The principle upon which this lamp is designed is not new, but has required much time and research to bring to its present efficient state of development. Certain non-conductors at ordinary temperatures, become conductors when heated, and highly incandescent if a sufficiently high temperature is produced. The necessary conditions are secured in the Nernst lamp by three primary elements, termed the glower, the ballast or regulating resistance, and the heater.

The glower is made by pressing through a die, a dough formed of the oxides of certain earths, mixed with a suitable binding material. The porcelain-like thread thus obtained is cut into suitable lengths, dried and roasted, and finally welded to the leading in wires of platinum by an electric arc, making a strong joint with good contact. The adjustment of the glower for the proper voltage is obtained by varying its length, a low voltage requiring a shorter glower than for a high voltage.

The resistance of the glower when incandescent being greatly less than when cool, requires that a compensating resistance or ballast be introduced to prevent an excessive current from flowing through the glower when heated, fusing and thus destroying it. A suitable length of pure iron wire is enclosed in a tube which is filled with an inert gas, hydrogen being the one used. The tube is then partially exhausted by an air pump until the correct density is obtained to permit the wire to convey the proper current, and then sealed off and the ballast is then ready for use. It is connected in series with the glower and thus prevents the flow of a current in excess of its capacity.

As the glower is a non-conductor when cold, it must be heated to enable the current to pass through it. The heating devise employed consists of a soft porcelain tube about the size of a ead pencil, wrapped with fine platinum wire andl then covered with a non-conducting protective paste, owing to the amount of platinum required; this is the most expensive part of the lamp to make. Two or more of these heaters are placed

horizontally just above the glower and in circuit with the latter when the current is turned on. The platinum wire quickly becomes heated and heats the glower sufficiently to allow the current to begin flowing. The passage of the current through the glower assists in its heating and it quickly becomes incandescent.

Connected in series with the heater, is a small cut-out, which remains closed until the current passing through the glower is great enough to excite a small electro-magnet, which, attracting a loosely suspended amature, opens the cut-out. When the lamp is not burniug, the cut-out operates by gravity to close the circuit through the heaters.

The quality of the light given by this lamp is an important factor in its favor; it more nearly approaching that of daylight than any lamp now upon the market. As practically all the light is below the horizontal, the efficiency of the lamp is high, the claim being that the operating expense, to secure the same illumination, is about one-half that of carbon filament lamps. The latter form of lamp of the size generally used, 16 C. P., at 110 volts, uses 55 watts or about 3.4 watts per candle. The single glower Nernst lamp giving about 50 C. P. uses 88 watts, or about 1.76 watts per candle, or only 50 per cent of the current required for the filament lamp. Larger sizes are of slightly greater efficiency. The material saving to be effected by the use of these lamps is easily computed.

Of the various sizes now being manufactured, the one most likely to interest readers of this magazine is the 110 volt, 8 amperes single glower indoor lamp with Edison base which can be used upon any vertical socket, no lamp being made as yet for side wall brackets.

While the first cost is higher than could be desired, the saving in operating cost and long life for all parts make this a matter of much less importance than would otherwise be the case.

PROJECTION.

Carl H. Clark.

IV. TRIANGULAR PRISMS.

To draw the projections of a hollow triangular prism lying on one of its faces, and having its axis inclined at an angle of 30° to the vertical reference plane —

A prism may be taken with faces 2″ wide and 2½″ long and with sides ½″ thick.

A line is drawn as the axis making the required angle of 30°, and on this axis the end view is constructed, being, as shown, an equilateral triangle with sides 2″ long, with a smaller triangle inside, thus having a ½″ thickness.

The plan view is next constructed on the axis already drawn, by laying off the length of 2½″ in a convenient position. Since the prism is rectangular the ends will appear as straight lines when looking down upon it in the plan, so they may be drawn 2½″ apart and at right angles to the axis. The width of the plan is obtained from the end view by projecting the points parallel to the axis, and the plan is completed by drawing the lines showing the edges, at the width obtained from the end view. The lines showing the corners of the triangular hole are of course dotted as they are inside the prism and cannot be seen.

The side view or elevation is obtained by combining the views already drawn. The end view shows the height of all points, and the plan the lengthwise position. The heights of all points are taken from the end view and transferred above, and a horizontal line drawn through each; then by projecting each point from the plan vertically onto the proper horizontal line above they are all located, and all that is necessary to complete the elevation is to connect the proper points with straight lines. The corners of the hole can be obtained in the same manner. The right hand back edge and the corners of the hole are dotted, as they are behind the body of the solid.

The right hand views are elevation and plan of the same solid, with its axis making

of 30° with the vertical plane as before, and also inclined so as to make an angle of 30° with the horizontal plane. The elevation just drawn is reproduced, with its axis making the 30° angle with the horizontal. Now by projecting points

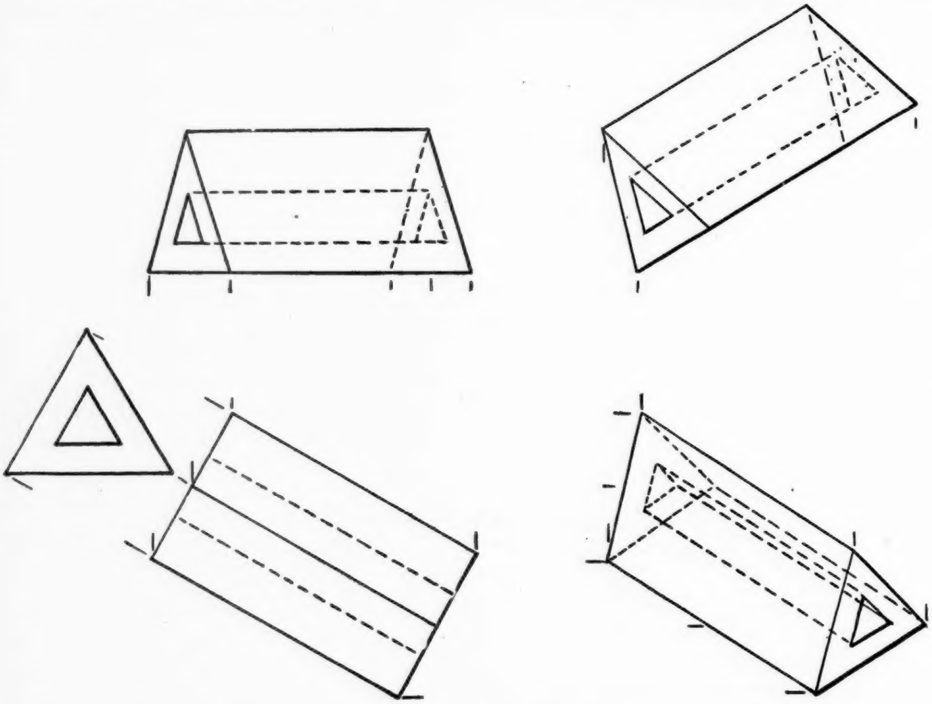


Fig. 16

down from this last figure and across from the first plan and connecting the right points the projection of the prism in its new position is obtained.

The method just outlined is rather different from what has already been used, and is introduced to give the reader a rather clearer idea of the process of making the several views of any object required for practical work.

It will be noticed that the horizontal and vertical projecting planes, and the traces of these planes, have been outlined for the present, as by this method they are not needed, and for solids which are not too complicated it is a very simple and direct process.

The attention of the treasury department at Washington, says Electricity, has been called to the necessity for some additional protection to public vaults on account of recent burglaries. The vaults which it is necessary to construct in public buildings are principally of a fireproof character, and make no pretensions to burglar-proof qualities, so that it seems essential to provide some electrical protection, such as is usually installed by banks and commercial houses. Secretary Shaw has therefore submitted to Congress a request for an appropriation of $30,000 for the installation of necessary electrical protection to vaults in various public buildings.

A cable dispatch from Berlin says that Siemens & Halske, after extensive experiments with Prof. Pupin's long distance telephone invention, have acquired his patents for Europe, and intend to connect all the great centres. The experiments have shown that with the Pupin wire a message is plainly audible to a person standing more than 10 yards from an ordinary receiver.

PORCUPINE BOILER FOR HEATING HOUSES.

William M. Francis.

II. SETTING FOR BOILER.

In the chapter describing the construction of the porcupine boiler, the setting was shown to be two bricks thick. While theoretically it is better to confine as much heat as possible, so that it will be used in heating the boiler; yet if some of the heat radiates from the setting, it will help to keep the cellar warm, and the difference in the warmth under foot in the lower rooms of the house will be noticeable. Some heat will also find its way up through the walls, which will also help out. For this reason, as well as the fact that it is easier to build a setting one brick in thickness, (or about 4 inches); which, if plastered over to make a neat appearance, will be about $4\frac{1}{2}''$ or $5''$ thick in the part which surrounds the boiler. This part of the brickwork will never, at this thickness, be so hot but that the hand can be placed on it.

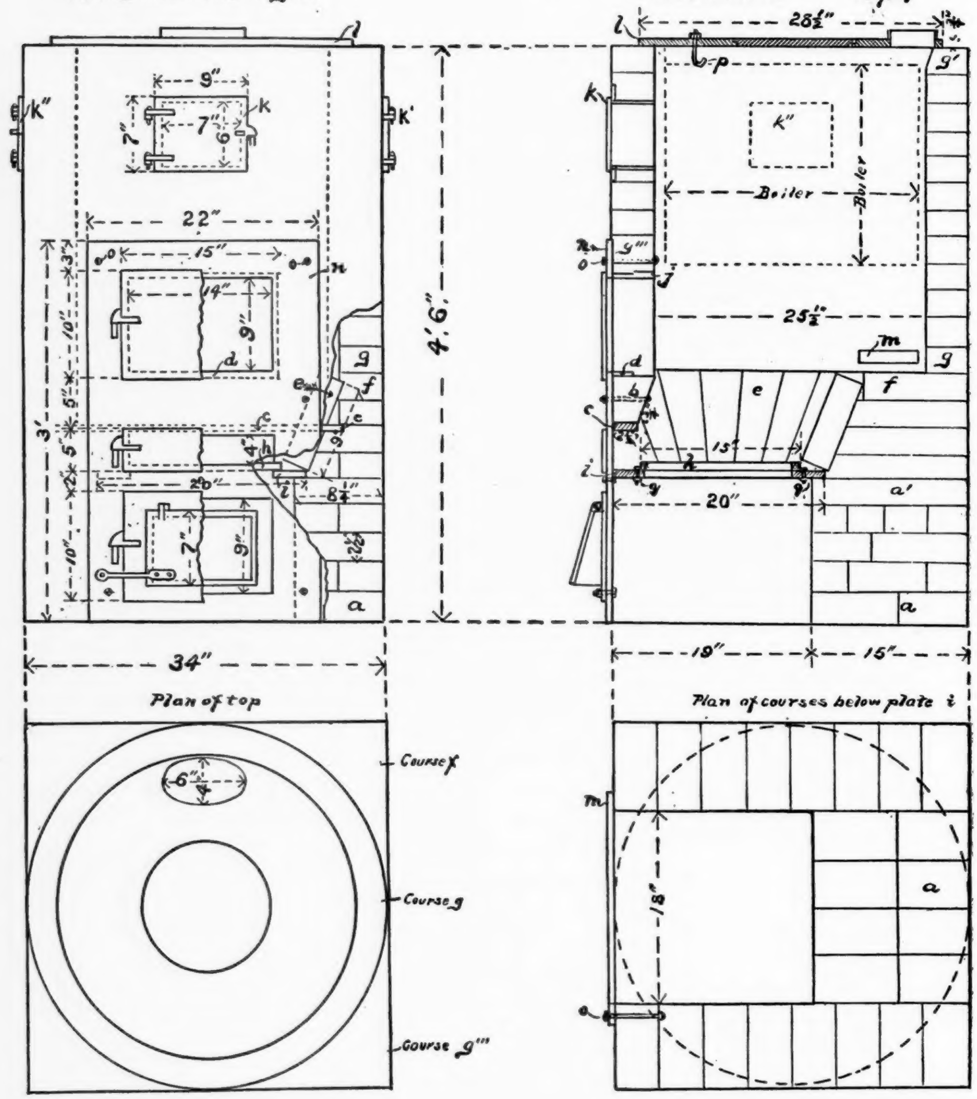
As the bricks will have to be laid to suit the fire and ash pan doors, it is necessary to first obtain these, and if plate N, Figs. 1 and 2, which holds the doors, can be obtained of a circular pattern, a better looking job will be made and the bricks will be more easily arranged where the fire bricks join those around the fire door. Almost any foundry agency carries a line of these doors. The plate n, Figs. 1, 2, and 3, with the doors all fitted, as well as plate i and grate h, Figs. 1, 2, and 3, were obtained at a cost of $10.00. The doors k, k^1, k^2, Fig. 1, were purchased for 30 cents each. If a pattern can be found that has the ledge d, Figs. 1, 2, and 3, so that it will extend the whole width of a brick, instead of as shown, it will be much easier to anchor the fire bricks b, Figs. 2 and 3. C and j, Figs. 1 and 2, are pieces of bar iron about $\frac{3}{4}'' \times 2\frac{1}{2}'' \times 27''$ or $28''$ long. C is in a poor place, being right in the fire and will have to be renewed at intervals but the space here is not sufficient to turn a brick arch which will hold up any length of time. C is protected in a measure after being in use for a couple of hours, by the fire becoming dead under it and filling with ashes. The plate l, Fig. 1 and 2, may be the top of a circular stove, like those that were used in railroad car heating a few years ago. The cover in the centre is very convenient to use when blowing soot off the boiler with steam. If such a plate cannot be obtained, a pattern may be made of pine boards to dimensions shown, but this will be much heavier.

The bricks needed will be common red, about 400 (allowing for breakage), and fire brick, about 25 or 30. These may be bought of a circular pattern but it is doubtful if they can be found beveled to the right angles. I hewed mine out of ordinary fire brick with a hatchet, and by taking light chips, managed, after breaking some, to get a good smooth job. About $\frac{1}{2}$ barrel of lime, $\frac{1}{2}$ barrel of sand, and a couple of buckets of kaolin to set the fire brick in, are also needed.

We will now start to set the bricks. First, if the cellar has a concrete floor, rough it up a little with a pick axe (not really necessary) and give the spot a good wetting down. Also soak the bricks in a tub of water. If this is not done the brick will absorb the water out of the mortar so fast that it will harden too quick to set the brick in place properly. The mortar should be quite thin. Lay the first courses from a to, and including a^1, as shown in plan, Fig. 2. The next course to a should be laid as shown in Fig. 1 to form what is called bond, or breaking the joints, and in some places it will be found necessery to break bricks in order that two joints will not come together.

Next put in plate i and grate n. Bolts q are six in number, inserted in plate i so the grate lies loosely between their heads. Now prop, or otherwise secure plate n in position, and build courses up until bar c, Figs. 1, 2, and 3 can be put in position. Set fire bricks b and a, Figs. 2 and 3, in kaolin mixed with water rather thinner than the mortar. The plate n should be drilled as shown in Figs. 1 and 2 so that the bolts will come between courses of bricks, and as the work

Front elevation, Fig. 3. Side section Fig. 4



proceeds the bolts should be inserted in their places, and set up just tight enough to hold. After everything is dry, set up firmly. Now build courses from a to f inclusive. After this has set a little, build from the grate up to nearly level with the top of fire door, with wooden blocks which can be taken out of the door or burned, a support to set the boiler on. Set the boiler on this and proceed to build courses from g to g^{I}, Figs. 2 and 3, putting in bolts and doors as you proceed. All pipes, i. e., steam outlet, return inlet, diaphragm pipe, water column connections should be put in their places and built in when the boiler is put in place.

Now put the plate l in position, and locate the holes for four or five hook bolts, p, Fig. 2. These hook on to some of the 1″ radial pipes of the boiler. Drill the plate and set it in place in mortar and set the nuts up enough to put a little weight on to the plate l to settle it evenly in the mortar. In laying courses g, Fig. 3, in order that the bricks may not have to be broken, they are laid as shown in Fig. 3, the V spaces being filled in with mortar and broken brick. The next course to g is laid as at s, Fig. 3. This makes a rough looking job but it can be plastered up to a smooth circular form if desired.

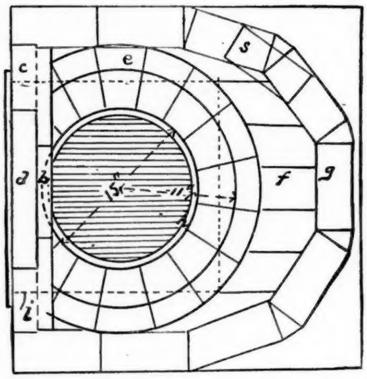


FIG. 5

The oblong m, in Fig. 2 is a common water back for a stove, but placed here to connect with the usual house service to give a continuous supply of hot water, a very desirable addition to the house service. After allowing the mortar to harden a day or two, set up bolts p good and firm, also bolts o, and remove the blocking from under the boiler. The pipes which go through the brick work also help to support the boiler.

The boiler fittings, piping, radiators, and management of boiler will be given in the next chapter.

USING THE TIDES.

Mr. James Swinburne, president of the Institution of Electrical Engineers in his inaugural address delivered Nov. 13 in London, refers among other interesting things to the tides as a possible source of energy. Mr. Swinburne does not think a tidal scheme for generating electric power practical and gives his reasons at considerable length. He states, and justly, too, that turbines to work on variable pressures or any sort of storage, means large capital expenditure, and it is the great capital expenditure that wrecks tide schemes. He adds: —

"It is often said that a Norwegian fjord or a Scotch loch could be easily dammed and utilized, but it would be impossible to find three lochs all opening out together. The need for more than one reservoir does not seem to have been recognized.

A tidal scheme is being tried at Ploumanach on the northern coast of France. In this region there is a difference of tide level of about twenty feet. A natural pond, triangular in shape, with its base towards the shore, is separated from the sea by an embankment. The pond has an area of about four acres. In the embankment are automatically operated gates that, owing to the angle at which they are placed, open when the level of the sea exceeds the height of the water in the pond, while they are closed by the weight of the water in the pond when the tide recedes. This head of water is utilized to turn two water wheels which operate dynamos, the current generated being utilized for lighting purposes. A storage battery is also made use of for storing the surplus energy. Whether the enterprise is a success in a financial way would seem rather doubtful.

The gas engine, says the Electrical Review, seems to be slowly but surely making its way in electric generating stations. This type of engine has recently been installed in a number of factories, not only in connection with a blast furnace, where it can be used wiih the greatest economy, but even where an independent gas producing plant was required. A striking feature of some of the plants will be the operation in parallel of direct connected gas engine driven alternators; these engines here performing the work for which they were until recently supposed to be least suitable.

AMATEUR WORK

63 KILBY ST., BOSTON

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JANUARY, 1903.

Contents

The description of the steam boiler given in this issue, should receive the attention of any readers in need of an economical and efficient system of heating. The operation of this boiler has been personally investigated by the editor who is much pleased with the results attained. The coal consumption is much less than that of any hot air furnace of the same heating capacity. Soft coal, screenings, and other of the cheaper grades of fuel may be used, and the boiler may be made by anyone with a fair degree of mechanical skill at such small cost as to put it within the reach of those who are unable to obtain their usual supply of anthracite coal.

THE publication of the December and this issue of this magazine was greatly delayed by a severe fire in the building in which were located the electrotypers, pressmen and binders. The fire occurred on the morning when the first form of the December number was to have gone to press, and in the height of the busy season, the publication elsewhere was therefore delayed. The next number will be about on time, and we feel sure our readers will, under the circumstances, excuse the delays, which were unavoidable.

WE are pleased to announce the preparation and early publication of illustrated articles giving complete directions for making a turning lathe, dynamo and gas engine; the latter being designed to furnish the power for running the others. Also a model gas engine and a steam engine, both one-fourth horse power, and dynamo to run with same. These, together with others which are about ready, will make the several issues of the current volume of decided interest and value to our readers.

PREMIUM No. 43, Blow Torch, is temporarily withdrawn from the list, as we are unable to obtain any more from the manufacturers, they being too busy on other lines of work to make up a stock at the present time.

An effort is being made in Sweden to use electricity in agriculture. A seed field is covered by a network of wire, and a strong electric current is turned on during nights and chilly days, but cut off during sunny and warm weather.

WOOD TURNING FOR AMATEURS.

F. W. Putnam, Instructor Manual Trainimg School, Lowell, Mass.

IV. THE RECESSED CYLINDER.

Before starting with the second exercise, the recessed cylinder, I wish to quote the following, on the finishing of a cylinder neatly and correctly, from Holtzapfel, who is considered to be one of the best, if not the best authority on turning and lathe work.

"The first traverses of the chisel remove the marks left on the cylinder by the gouge, and the tool is then made to travel from end to end of the work, at an easy pace and pressure, that it may remove an equal quantity all along it. The equality or otherwise in the thickness and width of the shavings produced, serves as a guide to show whether the rate of traverse and the angular position of the tool, have been correctly maintained. That portion of the cylinder having the smallest diameter, being ascertained, the calipers are fixed to that size and the whole cylinder reduced to it. The portions in excess are reduced by shavings commenced at the larger diameter, and made to gradually die away to nothing in the course of the traverse to the smaller, effected by gradually lowering the handle to vary the tangential position of the tool, until it entirely ceases to cut. The calipers being frequently tried from time to time, to find when the reductions have been carried sufficiently far to leave the cylinder true or everywhere equal in diameter. To obtain a delicate equal shaving the entire length of a cylinder or cone, or for a fine shaving that must begin and end in nothing, employed to correct the work when that is moderately small in diameter, and not far from its true or finished line, the chisel may be held in a different manner with advantage. The left hand, the back uppermost, has the whole of the fingers placed from above lightly around the work, which revolves within them; the left thumb is firmly pressed on the flat of the chisel, upon or just beyond the grinding, so that the under bevel of the blade is pressed on the work and forced to assume the most accurate tangential position. The right hand is shifted from the handle up to the blade, which it holds lightly on the rest, having only to assist in maintaining the tilt and to prevent the tool falling away from the cut by any lowering of the handle. The right forefinger is then sometimes stretched out along the side of the chisel, the traverse of the tool being much assisted by the left thumb, which aids by pushing the chisel along the cylinder at the same time that it keeps it in accurate contact."

Second Exercise — Recessed Cylinder.

The piece turned up for the first exercise may be used for the recessed cylinder shown in Fig. 29. The cylinder is turned to $1\frac{3}{4}''$ diameter and carefully tested with the calipers. If found to be perfectly straight, and of the required diameter, it is next to be marked out. This may be done either with dividers or with rule and pencil. Use a medium hard pencil, as a soft pencil will make too broad a line. Recesses are to be cut in the alternate spaces between the marks, as shown in Fig. 29. These recesses may be started and finished in three different ways.

First Method.

The first method involves the use of the skew chisels alone. The central recess, being the farthest from the ends which are supported by the head centre and tail centre, is to be finished first. Start the recess by holding the open chisel in the position shown in Fig. 30. The cutting point is the acute angle and is held down and a little inside the mark, with the bevel which is on the side on which the cut is to be started having the same direction as the cut to be made. The dotted lines indicate the first position of the tool.

Raise the handle and force the corner of the chisel into the wood for a short distance, repeating the operation on the other side of the space to be cut out. The material between these two cuts is to be removed by the skew chisel in the same way as when turning the cylinder, cutting

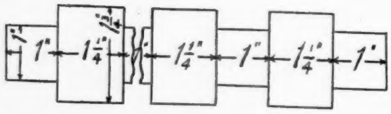


Fig. 29

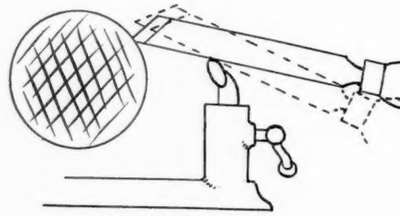


Fig. 30

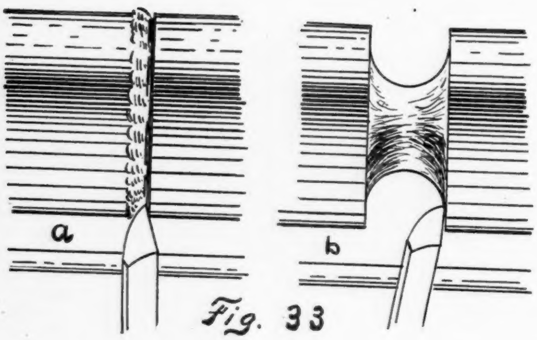


Fig. 33

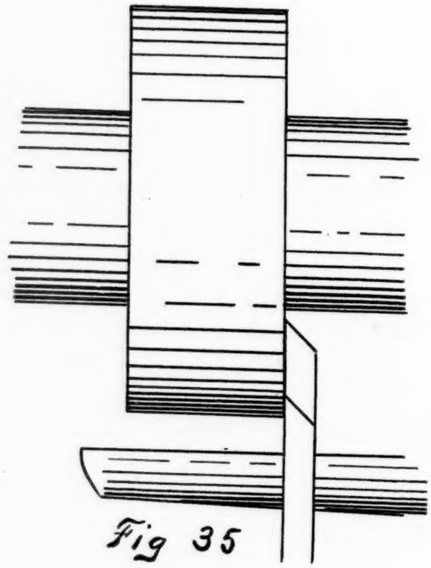


Fig 35

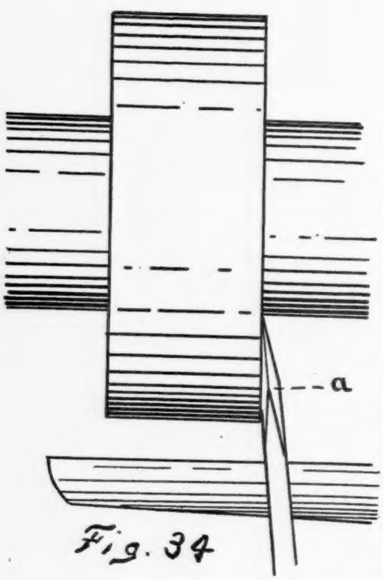


Fig. 34

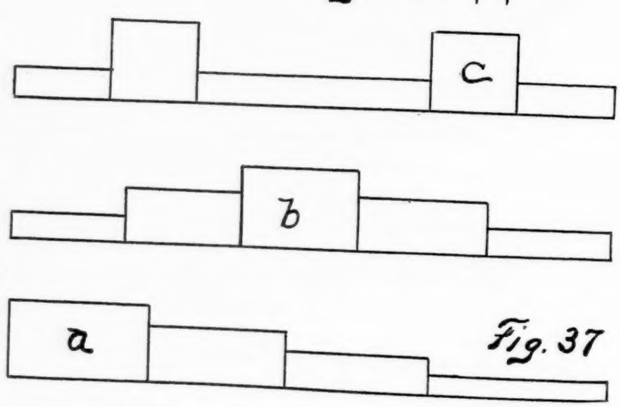


Fig. 37

with the obtuse angle. As the space between the shoulders is but 1″ the ⅜″ and ¼″ skew chisels must be used. In holding the chisel be sure to give enough clearance between the under bevel and the stock so that the acute angle will not catch in the block and spoil it. The position of the hands when holding the skew chisel is shown in Fig. 31. It will be noticed that the knuckles of the fingers come underneath, instead of uppermost, as was the case in the use of the large skew chisel on the cylinder.

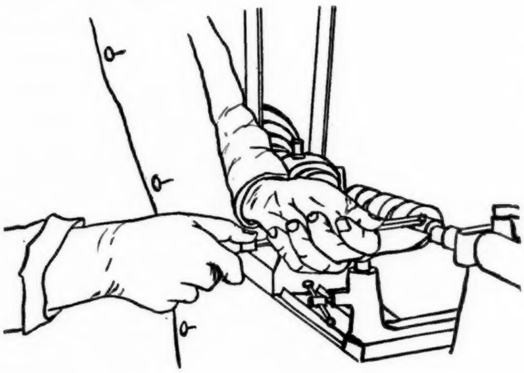


Fig. 31.

This position is often used where a final shaving is to be taken with a narrow skew chisel, the hands holding the chisel in such a way as to naturally give the necessary clearance between the stock and the under bevel of the chisel. Do not finish the shoulders until the recess is very nearly down to the required diameter 1″. The shoulders may be finished by the skew chisel in two ways. The first method is shown very clearly in Fig. 34. In this method the acute angle of the chisel is used for finishing the shoulders, the tool being held much the same as when starting the cuts.

The obtuse angle must be kept clear of the wood, this being done by holding the chisel so that the edge shall take the position relative to the side of the shoulder as shown in Fig. 34, at [a]. Always keep the corner of the chisel not in use clear of the work, when removing the material from the shoulders.

The second method of finishing the shoulders is shown in Fig. 35 and Fig. 36, the latter being taken from a photograph. The cutting is done with the acute angle the same as in the first method, but the chisel is held so that the straight edge back of the cutting point comes up against the shoulder that is being cut serving as a guide to keep the shoulders straight and at right angles to the recessed surface. This really is more of a scraping method than a cutting one, but is frequently used, especially in face plate work. Care must be taken not to cut down too far with the acute angle when shouldering, and also not to cut into the shoulder with the obtuse angle when finishing the recessed surface. The shoulders are to be tested by the end of a rule or a steel scale. When ready for a final test of the shoulders, take the block out of the lathe and hold it up to the light, using the rule or scale.

Second. Method.

In the second method of starting and finishing the recessed cylinder, the parting tool is used for starting the recess. Fig. 32 shows the position of the hands when the parting tool is used for this

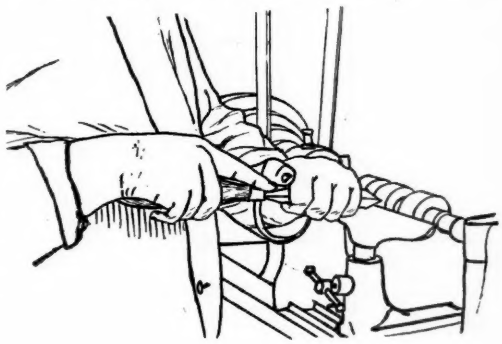


Fig. 32.

work. The cutting edge of this tool should come very nearly on a line with the centre of the block, and so the right hand, which holds the handle, must be raised gradually as the parting tool cuts down in for the recess. The cuts are made a little distance inside the lines, as the tool is scraping rather than cutting, and the shoulder left by this tool would be decidedly rough. This tool will be used to cut the recess to 1⅛″ diameter after which the small skew chisels are to be used for finishing the shoulders and the recessed surface, exactly the same as in the first method. Care must be

taken not to force the parting tool down too rapidly, as the temper may be drawn from the edge.

THIRD METHOD.

The third method makes use of the $\frac{1}{4}''$ and $\frac{3}{8}''$ gouges for starting the shoulders, the skew chisels being used only for the final finishing of the shoulders and the recess. The special use of the gouge for a concave curve will be carefully taken up in a later exercise, but the following directions should be sufficient to enable the amateur to use the gouge for this exercise without any trouble. The material between the shoulders must be removed by a series of cuts. Fig. 33 [a]

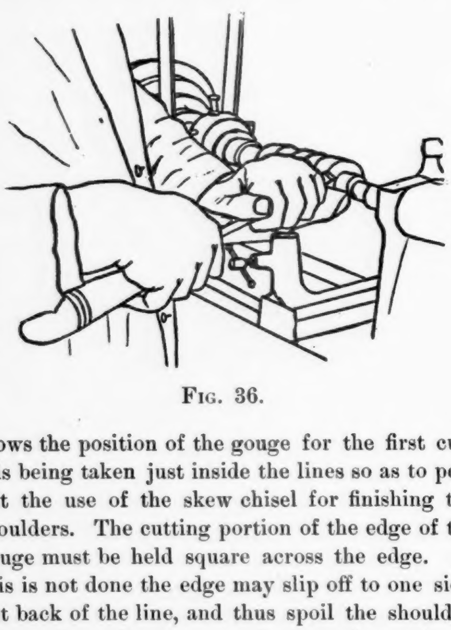


FIG. 36.

shows the position of the gouge for the first cut, this being taken just inside the lines so as to permit the use of the skew chisel for finishing the shoulders. The cutting portion of the edge of the gouge must be held square across the edge. If this is not done the edge may slip off to one side, cut back of the line, and thus spoil the shoulder. Do not force the gouge too far into the stock until the operation has been repeated on the opposite side. Where the second side is cut, the gouge may be forced a little farther into the wood, and is to be slowly turned over on its back, the under bevel on the gouge coming in contact with the stock. In finishing this concave curve, as shown in Fig. 33 [b] be sure to keep the bevel in close contact with the work throughout the whole movement of the gouge.

With regard to the three methods described above, it will be found upon trial that the first method will prabably be the longest of all, the second one the shortest, and the third method the hardest one to do, as great care must be taken at first not to catch the gouge in the stock.

After this exercise has been successfully masmastered, the amateur should have little difficulty in the accurate turning of a shoulder.

Three modifications of this exercise are shown in Fig. 37.

[a] represents double stepped cylinders. [c] represents large and small cylinders.

If further practice on these exercises is desired, a towel roller may next be turned. Take a clear dry stick of birch or maple 2′ long and 3″ square. Turn this down to $2\frac{1}{2}''$ diameter with the shoulders $\frac{7}{8}''$ diameter, the cuts being each 1″ long.

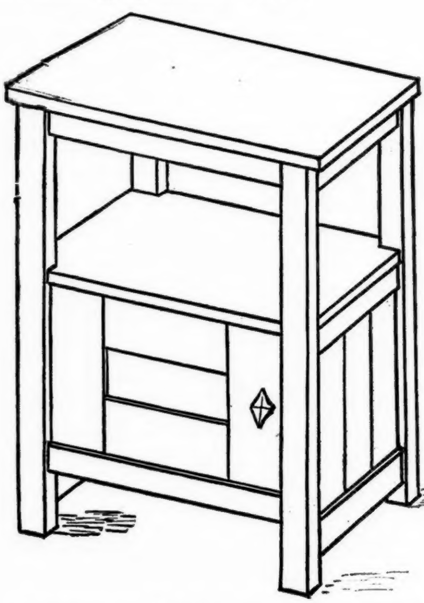
It will be found that both the gouge and the skew chisel must be held with the handle more nearly horizontal than is the case in soft wood turning. Before undertaking this kind of work in hard wood, the beginner must see to it that his turning tools are kept sharp and in first class condition. One of the first things to surprise the beginner, if he is using hard wood, will be the easy generation of heat. Great care must be taken in cutting shoulders and recesses with the skew chisel and parting tool, or the temper will be drawn from the tools. The tools should be forced in only a little at a time, and should be quickly withdrawn. If the temper is drawn from the edge, a dark spot will show on the edge of the tool, and this injured part must be ground away. A tool may even be quite seriously injured by this frictional heat in the turning of soft dry pine. The next article will take up the third exercise, the turning of the reversed cones, and the fourth exercise, the turning of heads and fillets.

The Great Central railway in England is experimenting with an electrical device for automatically controlling the placing on the line of the detonators used by railways as signals during a fog. The apparatus is operated electrically from the nearest signal box, the primary object of the invention being to cover the interval between the sudden approach of a fog and the arrival of the signalling men on the line. The arrangement has been put on its first trial at Lutterworth, which so far is said to have given satisfactory results.

A SOMBO.

JOHN F. ADAMS.

THE sombo described below is designed to accompany the bed previously described, and should be made of the same kind of wood with the same finish. The posts are 29″ long and 2″ square. Mortises for the side pieces of the cupboard, $1\frac{1}{2}''$ long and $\frac{1}{2}''$ wide are centered and cut clear through, the lower ends of the mortises being $2\frac{1}{2}''$ and 16″ from the lower ends of the posts. Connect these mortises on the inner side with a groove $\frac{1}{4}''$ wide and $\frac{3}{8}''$ deep for the panels. The mortises for the cross pieces supporting the top are $1\frac{1}{2}''$ long $\frac{1}{2}''$ wide and 1″ deep, centered and cut in from the tops of the posts. Mortises $1\frac{1}{2}''$ long and $\frac{1}{2}''$ wide are also cut through for the front cross piece under cupboard, the lower end of mortise being $4\frac{1}{2}''$ from the floor.



The front and back cross pieces under the top are 20″ long, 2″ wide and $\frac{3}{4}''$ thick, allowing 1″ on each end for tenons cut to fit mortises in the posts. The side pieces are 14″ long, allowing 1″ on each end for tenons. The front cross piece under cupboard is 23″ long, 2″ wide and $\frac{3}{4}''$ thick, allowing $2\frac{1}{2}''$ on each end for tenons, the upper sides of which should be flush with the upper edge, the wood cut off being on the under side only. The ends of these tenons are beveled $\frac{3}{8}''$ to a V shape. The side cross pieces to cupboard are 17″ long, allowing $2\frac{1}{2}''$ on each end for tenons, the ends also being beveled as above and a groove $\frac{1}{4}''$ wide and $\frac{3}{8}''$ deep being cut on inner edges for the panels. The top is 24″ long, 18″ wide and 1″ or $1\frac{1}{4}''$ thick, giving a 1″ overhang at the posts. Owing to the width it will undoubtedly have to be glued up from two pieces, and planed off when the glue is thoroughly dry. It is attached to the frame with screws as follows: Bore two $\frac{1}{2}''$ holes half way up through each of the supporting pieces and then carry the holes clear through with a bit of the size to match the screws. It would be well to coat the top edges of the cross pieces with glue.

The top of cupboard is 21″ long, 15″ wide and $\frac{3}{4}''$ thick, and is fastened to the side pieces by screws put in as above, except that the holes are bored through at an angle from the inside. The corners will have to be cut out to fit posts, using care to have a good fit. The panels at sides are $12\frac{5}{8}''$ wide, $11\frac{5}{8}''$ high and $\frac{1}{4}''$ thick, allowing $\frac{5}{16}''$ all around for fitting to grooves. It would add to the appearance if three shallow grooves were made with a V carving tool to give the appearance of strips instead of a solid piece. The door is 18″ wide and 12″ high and made as follows: The two pieces at the ends are 12″ long, 4″ wide and $\frac{7}{8}''$ thick; the cross pieces are 18″ long, 4″ wide and $\frac{7}{8}''$ thick, the joints being made by "halving," secured by glue and a few short screws. Grooves $\frac{1}{4}''$ wide and $\frac{3}{8}''$ deep are cut on the inner edges for the panel which is $4\frac{5}{8}''$ high and $10\frac{5}{8}''$ wide, the grain running vertically.

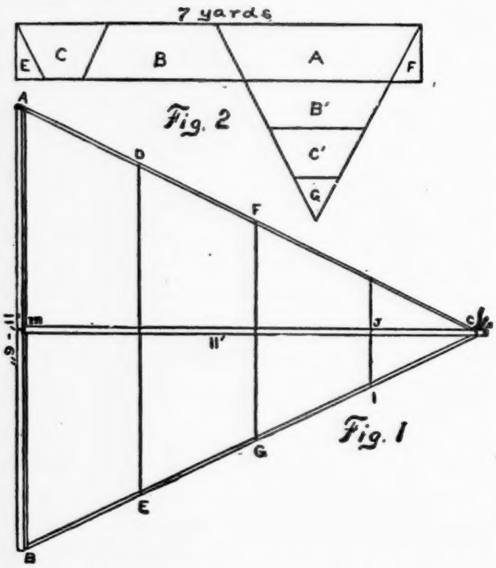
The floor of cupboard is made of any suitable wood fastened to strips screwed to the lower front and side cross pieces, the top being flush with the top edge of the lower front cross piece. The back of the cupboard is of $\frac{1}{2}''$ wood fastened to strips screwed to the top and floor. The door is attached to the left corner post with two hinges of ornamental black iron if same can be obtained, and is set in about $\frac{3}{8}''$. An iron pull knob at the right side, and a catch of some kind are also necessary.

HOW TO MAKE AN ICE-SAIL.

Leslie D. Perry.

The accompanying plans and specifications refer to a seven-yard ice-sail, as this is large enough for all practical purposes. By the same general plan ice-sails of any number of yards can be made.

The cotton should be of heavy weight, usually costing eight cents per yard. Some prefer ducking, but this is too heavy and more expensive. After buying the cloth, lay out with chalk on an uncarpeted floor two lines, a vertical one 11′ 6″



long, and a horizontal 11′ long and perpendicular to the vertical at its centre, to represent the base and altitude of the ice-sail. Connect these lines to make the outline of the sail, as in Fig. 1. As shown in both figures, but especially in Fig. 2, the cloth can be applied to the outline and cut in such a way as to waste very little of it, and yet have the corresponding edges of the cloth next to each other. The large pieces, A, B, C, will coincide with the pieces, A′, B′, C′, and if cut right the pieces E and F will be more than enough to make piece G. Anything remaining can be used to reinforce the corners.

Baste or pin the separate pieces together and obtain feminine aid in sewing them, which may be done on a machine. At the lines of joining, DE, FG, HI, JC, and at the edges, AB, BC, and AC, a wide hem should be kept. Pass light ropes through the three hems at the edges, fastening them at the corners A and B but leaving them to come out at C. The corners A and B are sharp but C is blunt, and between the ends of the hems where the ropes come out a steel ring is sewed on. The purpose of this arrangement is to tighten the edges and the body of the sail, and prevent sagging.

The poles should be of pine, $1\frac{3}{8}''$ square with the edges smoothed off, and 11′ 6″ long. They may be obtained at any wood-working shop for ten cents apiece. To connect them, bore a hole with a gimlet through the pole AB at the centre M, and at the end M of the pole MC drive a 3″ wire nail with its head cut off, half way into the cross-section of the pole. The remainder of the nail fits into the gimlet hole and the tightened cloth holds the poles together. Bore smaller holes at the ends A and B, pass stout cord through the holes and tie the corners of the sail tight to the pole AB. At intervals between A and B punch holes in the hem inside the rope, pass pieces of strong cord through them and tie the pieces tightly around the pole AB.

To fasten the other corner, C, bore a $\frac{1}{4}''$ hole through the pole MC 1″ from the end; pass a small piece of light rope through the hole and tie it into a ring; pass the ropes N and R, coming from the hems of the sail, first through the rope ring O, then back through the steel ring L, tighten them and tie them securely around the pole. The sail is then complete and ready for use. When through using, untie the ropes at C, take out the pole MC, lay it next to AB and roll them up in the sail, tying the roll with the ropes M and R.

A sail can be made much simpler by omitting the hems, ropes, ring, etc., but these items add greatly to the efficiency of it. The cost besides labor is about 90 cents.

Equipped with a sail as described above, one can go through all the evolutions of a modern ice-yacht, in a much smaller space, if not with as much speed, at least with less danger and greatly reduced expense

FOOT-POWER BLOW-PIPE.

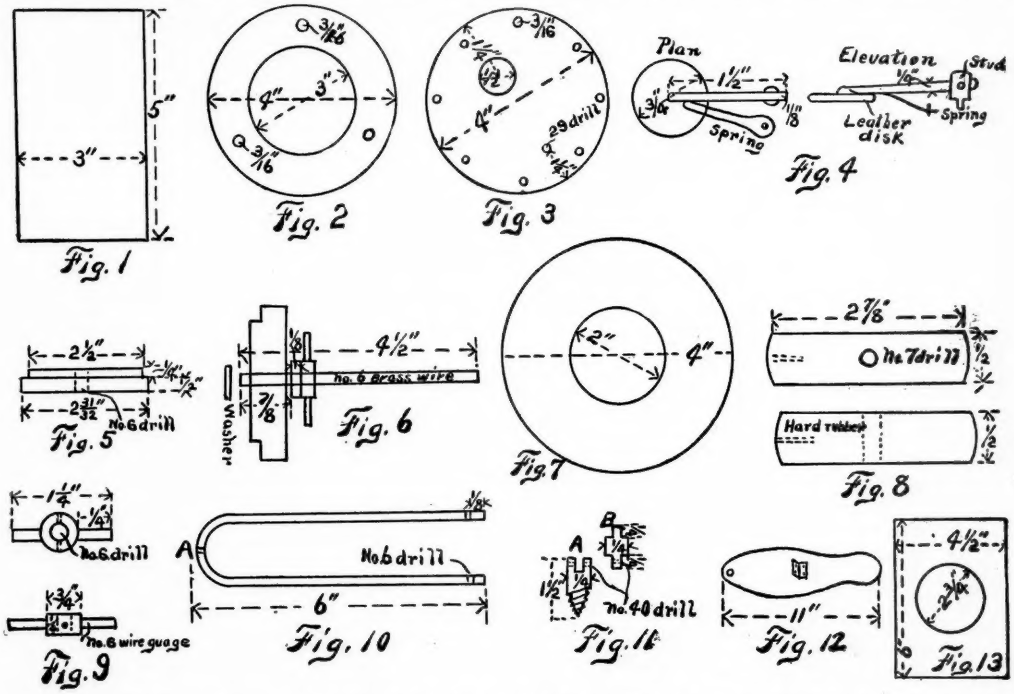
W. W. WATTLEY.

A DESCRIPTION of a foot-power blow pipe which I made and found exceedingly useful may be of interest to the readers of this magazine.

To each end of a piece of brass tubing, Fig. 1, 5″ long, 3″ internal diameter, and 1-16″ thick, is soft soldered a flange cut from 1-16″ sheet brass. The flanges are 4″ diameter. A 3″ hole is cut in the centre of one flange, Fig. 2, and also 3″ holes are drilled in it to receive 3-16″ wood screws by which the cylinder is secured to its base. The other, or top flange, Fig. 3, has a 1-2″ hole drilled with its centre 1 1-4″ from the peryphery to receive the retention valve. Opposite this hole and 1 1-4″ from the edge is another hole (29 drill) for receiving a slotted stud which is tightly riveted and intended to carry the arm of the valve shown in Fig. 4. A small stiff spring is also riveted to the cylinder head which keeps the valve closely in place. The valve consists of a disc of thin brass 3-4″ diameter, to which is soldered an arm of 1-8″ square brass 1 1-2″ long, with a No. 4 hole drilled 1-8″ from the end forming a hinged joint with the stud above mentioned.

On the under side of the brass disc is connected or glued a disc of soft leather to prevent leakage. When the valve is in position the spring is placed as shown in Fig. 4, the end pressing tightly on the brass disc. The piston, Fig. 5, is made of hard wood or rubber 2 31-32″ diameter and 3-4″ thick with a slightly tapering hub 2 1-2″ diameter which receives the leather packing. A No. 6 hole is drilled through centre to receive piston rod.

The piston rod, 4 1-2″ long, is made of No. 6 hard drawn brass wire. A washer 3-4″ diameter and 1-8″ thick is soldered 7-8″ from one end. The wooden or rubber piston is placed on this end of the rod, a washer placed on the protruding part and then riveted, thus securely holding it in place as shown in Fig. 6. The piston packing is cut from a thick piece of flexible leather of uniform thickness and is 4″ diameter with a 2″ hole cut in the centre. This hole is cut smaller than the tapering hub of the piston so as to allow it to be forced on, leather stretching considerably. (See Fig. 7.)



An arm (Fig. 9) is made of brass of the size and shape shown, the hub being cut out of a piece of 3-4″ round brass rod. The hole in arm is the exact size of the piston rod. The arm is pushed onto the piston rod till it touches the washer on the under side of the piston.

A No. 40 hole is drilled through both arm and piston rod and a pin pushed through and riveted. This arm is intended to carry the fork, Fig. 10, which is made from a piece of brass or iron 12″ long, 1-2″ wide and 1-16″ thick, bent V-shaped as shown. Two holes are drilled with a No. 6 drill 1-16″ from the ends to receive the ends of the arm attached to the piston rod. At the bend of the fork at A, another hole is drilled to receive the end of the stud B, Fig. 11, which is securely riveted in place. The other end, which is filed flat, is intended to mesh in the slot A, which is fastened by a pin passing through a No. 40 hole shown in dotted lines.

A guide, Fig. 8, keeps the piston rod in a perpendicular position during the stroke. It is made of hard rubber 2 7-8″ long and 1-2″ square with a No. 7 hole drilled at the centre. Two other holes are drilled at the extremities to receive wood screws, which pass through the cylinder near its lower end and hold the rubber bar in position across the cylinder flush with the rim.

The piston and arm having been riveted in place, the placing of the packing of leather is attempted. This is done simply by stretching the leather ring over the top of the piston, the ring previously having been soaked in machine oil to make it soft and pliable. After forcing it as far on as it will go without tearing, the outer edge is then turned upward. If the person who is making this pump will only examine the piston of an ordinary pocket bicycle pump he will find out exactly how it is done.

The packing having been properly placed, the inside of cylinder is thoroughly oiled and the piston carefully inserted. The rubber guide, Fig. 8, is then placed within the cylinder with the piston rod passing through the hole in its centre and the holes brought to correspond with those in the cylinder, so that short brass screws can be inserted. The piston is then pulled down as far as it will come and the fork hooked to the arm by spreading it open, and then allowing it to spring back in place. The cylinder is now complete and may be laid aside while the stand, treadle and air chamber are constructed.

For the stand, is required some hard wood 7-8″ thick, from which is cut two pieces 4 1-2″ long and 7 1-2″ wide. Also one piece 4 1-2″ long and 6″ wide which has a hole 2 3-4″ diameter cut in the centre and is the board to which the cylinder is screwed. The piston and connecting rod should pass freely through the hole.

This board is screwed to the tops of the two pieces first mentioned. Another board is cut for a baseboard, and inserted between the lower edges of the two side pieces and attached with screws. Another piece of wood is cut 12″ long in the shape of a shoe sole by placing the foot on the wood and marking with a pencil. A small hole is then drilled just beyond the toe of the shoe to allow the slotted headless screw, A Fig. 11, to be easily inserted. A hinge (any ordinary kind will do) is then screwed to the centre of the under art of the treadle which is then ready for mounting on the base of stand. A small block of wood 6″ long 1 1-2″ wide and 3-4″ thick, with the top slightly tapered is screwed across the base 4″ from the projecting end and the hinge on the treadle is then attached to it. At the extreme front end of the base is nailed a strip of soft rubber 1-2″ thick. This acts as a stop and prevents the piston from being plunged too far within the cylinder and the rubber cushion prevents any shock being caused by the sudden stop. The tongue of the stud B, Fig. 11, is inserted in slot A, and a strong pin passed through to secure it. Cylinder, stand, and

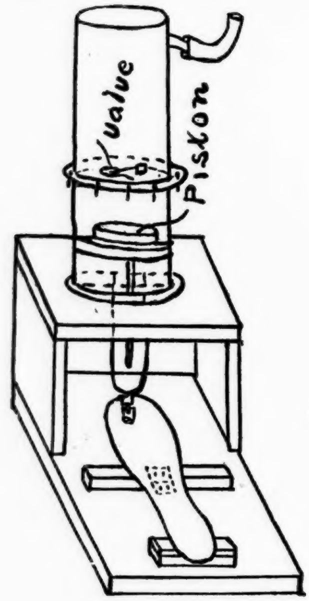


Fig. 14.

treadle are then complete and all that is required is the air chamber which is made of tinned iron to be procured of any plumber in sheets 14″x20″. Cut a piece 14″x9 3-4″ which must be turned into a tube 3″ diameter and 14″ long and the seam carefully soldered. From the same tin, a disc 3 1-4″ diameter is cut having 1-8″ of its edge turned up all around and this is soldered to the top of the tube, forming a head. At the side of the tube about 1-2″ from the top punch a 3-8″ hole into which is soldered a piece of tin or brass tubing of the same diameter and about 2 1-2″ long, care being taken to have it slanting downward as a small rubber hose is to be connected to this piece of tubing. Slanting the tube prevents the tube from "kinking," which otherwise would happen if a straight tube was used. At the other end of the tin tube which forms the air chamber, is soldered a brass flange exactly the same as in Fig. 3, which coincides with the one on the cylinder head with the exception that a 3″ hole is cut out the

entre forming a ring as in Fig. 2. The holes are made to correspond, and small bolts tightly secured in them to hold the two cylinders together. I may here mention that a packing of stiff paper smeared with paint may be placed between the joint which makes it air tight. A small rubber hose is forced over the projecting tube in the top of the air chamber, and the other end is mounted with a jeweler's blow pipe. A coat of paint is then applied to the whole and when dry the blow pipe is ready for use.

The materials required for constructing this one cost me about $2.00. This machine, with a suitable lamp, will be found exceedingly useful when a hot blast is required, such as tempering and hardening small tools, brazing, soldering, and melting small quantities of metals.

ACETYLENE.

I. ITS COMPOSITION AND PROPERTIES.

While calcium carbide, from which acetylene gas is produced, has been known to scientists for the greater part of the last century, it was not until 1892 that a way was found to manufacture it at a cost that made possible its use for commercial lighting. Thomas L. Willson, an electrical engineer at Spray, N. C., while conducting some experiments in an electrical furnace with a mixture of lime and coal, obtained a product which, differing from that desired, was thrown into an adjacent stream. To the astonishment of the observers, there was suddenly liberated a great quantity of gas, which on being lighted, burned with a very bright but smoky flame. A second experiment produced similar results, and thus, by accident, was a valuable addition made to the methods for obtaining illumination.

Calcium carbide is a hard, dry, opaque, solid substance, known to the chemists as Ca. C2, an expression signifying that one part calcium, is combined with two parts carbon, though the compound differs greatly from either constituent. It is generally of a dark brown or black color resembling a mass of stone; is crystalline and brittle. It may be heated to redness without melting and will not burn except when highly heated in oxygen gas. If kept sealed from air and moisture it may be preserved any length of time. If exposed to air for any length of time, the ordinary moisture of the atmosphere gradually slakes it, as it does ordinary lime; the two then being essentially the same when exposed to air, a penetrating odor is noticeable, due to the escape of acetylene gas, liberated by the atmospheric moisture.

It is affected to but little extent by solvents other than water; but in contact with water or any mixture containing water, an immediate and vigorous decomposition takes place, liberating large quantities of gas. It is therefore a safe substance to store or transport under proper conditions, as it will not explode, take fire, or otherwise do harm if properly protected from water.

Carbide combines with water in the proportion of 64 parts, by weight, of carbide, and 36 parts water, producing 74 parts slaked lime and 26 parts gas. As generally stated, a pound of pure carbide yields about 5.5 cubic feet of acetylene; but as commercial carbide is not chemically pure, the estimate is not more than 4.5 to 5 cubic feet of gas per pound of carbide. Acetylene gas does not take fire of itself but is easily lighted. If a small piece of carbide is dropped into a cup of water, the gas as it rises in bubbles to the surface may be lighted, thus giving a rough but practical demonstration of its properties.

Carbide is manufactured in an electric furnace, the heat being obtainable in an economical way only by this process. Electricity forms no part of the process, other than the production of heat. A mixture of 56 pounds of lime and 36 pounds of coke produces 64 pounds of carbide and liberates 28 of carbon monoxide gas which passes out the flues or is burned. The ingot resulting is a very pure carbide, surrounded by a crust of less pure carbide, due to incomplete combination. This is broken up, the crust being in part rejected, screened to sort into crystals of uniform size, and packed in sealed cans, of varying size.

Acetylene gas, C2 H2 is composed of 24 parts by weight of carbon and two of hydrogen, or about 92 per cent. hydrogen, having the highest percentage by weight of all the hydro-carbons. It is colorless gas, with a strong odor but burns in a proper burner *without perceptible odor*. If an odor is detected in a room or about a generating apparatus, it is evidence of a leak in the piping, an open cock or other outlet. Acetylene has a great affinity for water, an approximate statement being that a gallon of water will dissolve a gallon of gas; but this is not as serious an objection as might at first be thought. The water used in generating apparatus becomes saturated to a slight depth and prevents further absorption unless the water be agitated. It is very desirable that water once saturated be retained in the apparatus to prevent further loss of gas from this cause.

Acetylene burns with a brilliant but smoky flame. With a proper burner it gives a light of greater brilliancy than that of any other gas. For complete combustion, two volumes of acetylene require five volumes of oxygen, the residium being four volumes of carbon dioxide and two of water vapor. All combustible gases,

when mixed with certain volumes of air previous to ignition, will produce, when fired, more or less violent explosions. Acetylene possesses a somewhat wider explosive range than do similar gases, but this statement should be considered in connection with the much less quantity used in lighting, as compared with the gases commonly used, when the liability to explosion under normal conditions will compare favorably with them. Acetylene is not explosive, except when mixed with air as above stated, or under a great compression obtainable only in apparatus designed for the purpose, while slightly poisonous, it is less so than coal gas and grealty less than water gass.

When burned through a suitable burner, the flame of acetylene is absolutely white and of intense brilliancy. Its spectrum closely approaches sunlight, colors appearing nearly the same in both lights, making it a very desirable light for domestic purposes. Owing to its brilliant flame a greatly less quantity of gas is required to produce a given candle power, than with the ordinary illuminating gas, the ratio of brightness, with equal volumes of gas, being about twelve to one. The customary rate of consumption of acetylene per burner is one-half cubic foot per hour, yielding about 25 candle power. Herein is one of the great advantages of acetylene; the small quantity required and ease of generating, making entirely feasible small plants for domestic use. Seashore and country residences can thus be provided with the necessary equipment for satisfactory lighting at small expense for installation and maintenance. A description of the apparatus and its operation will be given in a subsequent article.

COLORED ELECTRIC BULBS.

Thomas A. Mitchell.

At the present time when colored electric bulbs are so generally in use for decorative and advertising purposes, it may be of interest to our readers to know an exceedingly inexpensive and practical method for preparing these bulbs for temporary uses. There are two common processes accessible to all: one may be called the glue method, the other the the pyroxylene or nitrocellulose method. The first is the simpler and requires no technical knowledge. It will be found a very easy and convenient way to color bulbs for use on Christmas trees and at amateur theatricals, lawn parties, etc., where electricity is available.

The process is as follows: — Prepare a thick glue solution by dissolving the glue in hot water, and add to this enough of a water solution of the desired dye (Diamond dyes are quite satisfactory) to give the required depth of color. The bulb is dipped in the bath and then allowed to dry with the lamp lighted. A point which is very much in favor of this receipt is that the films which are formed on the bulbs may be easily removed by soaking in hot water. Care should be taken not to wet the connentions as the cement will loosen and spoil the lamp for future use.

The other receipt consists of a solution of nitro-cellulose in amylacetate in which is dissolved a soluble dye. This dye is more expensive than the dye required in the glue method. This formula is, in all probability, beyond the reach of most amateurs as it requires some knowledge of the constituents in order to gain a favorable result. A very pretty effect may be obtained where transparent shades, such as white porcelain, are to be used, by streaking the bulb with small amounts of the different colored solutions.

Of course it is not to be expected that colored bulbs prepared by either of the above methods will retain their color as long as those bulbs made from colored glass. No dyes are absolutely fast to light, but of those dyes available for the purpose, reds will be found to be most permanent and blues least so. It is also obvious that any bulb coated with glue cannot be exposed to rain, and, therefore, for outdoor work the nitro-cellulose bulbs will be most lasting. Neither, however, is to be recommended for this use.

Despite these disadvantages, which are really insignificant, especially on low candle power lamps, very beautiful effects may be quickly and simply obtained provided the directions are followed carefully.

The "machine shop" number of Cassier's Magazine for December contains among other interesting articles one by W. M. McFarland, in which the author states that only when electric driving makes possible a 10 per cent greater output is the matter worthy of attention. He mentions that Prof. C. H. Benjamin investigated the conditions found in various shops, and out of 12 of these 10 required more horse power to drive the shafting than the average horse power load on the tools. These were, obviously, instances where independent electric driving should have been adopted.

Richard Guenther reports from Frankfort, Germany, that the city of Wiesbaden has constructed extensive ozone waterworks at Schierstein for the purpose of obtaining a drinking water entirely free from pathogenic germs. The works are capable of rendering 250 cubic meters per hour at a cost of 2 pfennigs (a little less than half a cent) per cubic meter. The ozone, generated by electric discharges in an apparatus composed of metal tubes, passes upward through coarse gravel contained in towers, while the water to be sterilized flows down and arrives at the bottom perfectly germless.

TRADE NOTES.

The S. H. Couch Co. telephone manufacturers have removed to 156 Pearl St., corner Atlantic Ave., Boston, where, with increased room and ample facilities, they will be able to provide for all demands in their line of high grade instruments.

The Atwater Kent Mfg. Wks. of Philidelphia, Pa. manufacturers of the Monoplex telephone, are sending upon request a small calendar on which is printed a pen and ink sketch of a girl of the Gibson type. This company report a fast increasing business, as the public become more familiar with their instruments. They are about to place on the market several systems of intercommunicating telephones.

CORRESPONDENCE.

Our readers are invited to contribute to this department, but no responsibility is assumed for the opinions expressed in these communications.

Letters for this department should be addressed to Editor of Amateur Work, 63 Kilby Street, Boston.

They should be plainly written on only one side of the paper, with a top margin of one inch and side margins of one-half inch.

The name and address of the writer must be given, but will not be used, if so requested.

Enclose stamps, if direct answer is desired.

In referring to other letters, give the number of the letter referred to, and the date published.

Illustrate the subject when possible by a drawing or photograph with dimensions.

Readers who desire to purchase articles not advertised in our columns will be furnished the addresses of dealers or manufacturers, if stamp is enclosed with request.

(No. 32.) Winsted, Conn., Dec. 11, 1902.

I have just completed the rheostat described in the Nov. issue of the magazine, and find it will not work. After trying several ways I have decided that the fault is in the carbon. Please advise the kind of carbon to be used. E. A.

The trouble you are having with the rheostat is undoubtedly due to the carbon. It should be very fine grain and very firmly packed. If you can get some imported arc-lamp carbons, which have not been plated; with a fine 2nd cut file, carefully file the carbon over a sheet of paper, you will be able to get some carbon granules which will be suitable. A description of how to make a rheostat of another form, is given in this issue, and you may find it desirable to make one after this model.

(No. 33.) Cambridge, Mass., Dec. 15, 1902.

In an article in the Nov. number of Amateur Work, it states that the rheostat should be placed on the positive pole of motor, coil, or whatever electrical device it is used with. Please inform me why this is so. W. A. C.

The placing of a rheostat on the positive wire to a motor or other electrical device, is a matter of custom. A rheostat regulates the current flowing, and would operate on either the positive or negative side.

(No. 34.) Boston, Dec. 17, 1902.

Will you please send me the name and address of a dealer carrying small dynamos. J. J. R.

The Seth W. Fuller Co., 185 Devonshire St., Boston, can undoubtedly supply you with anything in this line; or send to Carlisle & Finch, Cincinnati, Ohio, who make several sizes of small dynamos, and also supply the parts for making same.

(No. 35.) Cleveland, Ohio, Dec. 21, 1902.

Please give me the name of a firm selling hard rubber sheets. H. G. C.

Any electrical supply concern should be able to obtain this for you, as it is carried in stock by the large electrical supply firms such as the Manhattan Electrical Supply Co., Cortlandt St., New York.

(No. 36.) Fitchburg, Mass., Dec. 13, 1902.

I am making the Wimshurst influence machine described in the April number of Amateur Work and can find neither the tin-foil or the brass balls needed. Please inform me where I can obtain the above articles. G. B. S.

The tin-foil and brass balls for making the Wimshurst machine can be obtained of the Knott Apparatus Co., Ashburton Place, Boston, Mass. Many who have made this machine have used brass balls of the kind used for trimming brass beds. Chandler & Farquhar, 34 Federal St., Boston, also carry brass balls of some of the sizes needed.

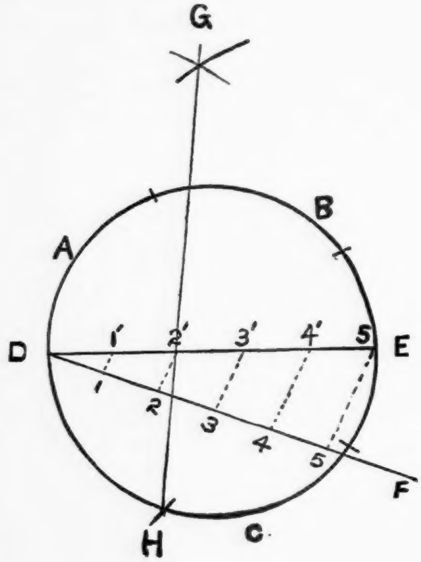
(No. 37.) Peru, N. Y., Dec. 30, 1902.

I have a small 20 watt dynamo with brass brushes If I run it any length of time, the commutator begins to bridge over and short circuit the machine. Do you think that carbon brushes would remedy the above fault? E. C. A.

Carbon brushes would probably not help matters on this size of dynamo. The sparking is probably caused by oil from the bearings or dust which has collected, or the insulation may have been poor and given out. Place the brushes in the position where they spark the least, carefully clean the commutator, and then try and see what result you get. If sparking still continues, the commutator probably needs new insulation. The information you send is too limited for a more definite answer.

(No. 38.) SHELBYVILLE, IND., DEC. 10, 1902.

Can you give me the geometrical proof for the following construction? — To inscribe a regular polygon of any number of sides in a circle?



Construct any circle, drawing diameter as D E. Divide diameter into as many equal parts as the polygon is to have sides, (in this case five). Then, with the radius D E (the diameter of the circle) inscribe arcs that intersect at G, using the extremeties of the diameter as centres. From the point of intersection, G, draw a line through the second division cutting the circle at H. From D to H is the length of one side of the polygon. The remaining sides may be stepped off with a compass. W. W.

This problem is given by Faunce as "an approximate method," and therefore not one which is covered by any one geometrical proof. It is of value to draftsmen when rapid work is the first consideration.

IMPORTANCE OF PEAT AS FUEL.

If the vast peat bogs of Ireland could be turned to good account the future of that unfortunate country would be far brighter, considered from an industrial point of view. The matter is regarded as great promise and enormous importance, therefore it is not at all surprising that the chairman of the Dublin section of the Institution of Electrical Engineers should select it as one of the chief points in his presidential address. The indifference of the gas engine to the food it gets was mentioned as one of its remarkable qualities. Its capability of using poor gas was stated by Mr. A. E. Porte, to point to it as the heat motor best adapted to obtaining power from the product of the Irish peat bogs, and yet those interested in the development of the peat industry had paid very little attention indeed to it. It is, however, nearly twenty years ago that the Royal Dublin Society appointed a committee to investigate peat fuel, with the result that a Siemens regenerative furnace was built at Inchicore for working up scrap iron, and this was fired with producer gas made from peat. The peat used contained from 38 to 40 per cent. of moisture and no difficulty was experienced in maintaining the temperature of the furnace. The average consumption was 5.09 tons of peat per ton of iron forged from scrap to finished work; 3 tons of coal would have been used under similar conditions, and 4.96 tons of the coal were used in an ordinary furnace. Mr. Porte thinks it possible that the ammonia might be recovered from peat. The evaporation of the moisture contained in peat amounts to some 15 to 20 per cent. in air-dried peat, and this is one great drawback to its use as an ordinary fuel, it absorbs so much of the heat of combustion; but in a producer this evaporation is carried out in the gases, the loss of which is almost inseparable from the operation of a producer.

The development of the steam turbine is being watched by engineers with great interest. Until recently no turbines of small power had been perfected which were sufficiently economical to compete with the oscillating type of engines, but recent inventions give promise that soon this will no longer be the case. As a source of power for electric lighting, an efficient turbine would quickly meet with a wide use.

Marconi has successfully transmitted messages across the Atlantic and all doubts are removed of the success, electrically, of long distance wireless telegraphy over water. The commercial success of this system of transmitting messages is still to be demonstrated, as many factors will have to be considered before this side of the question is settled.